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(54) Abstract Title
Actuating system having a hydraulic pump driven by an engine and electric motor

(57) A hydraulic actuating system, for an automatic transmission of a vehicle, comprises a hydraulic pump 10 drivingly connected to an engine, via gearing 14, and an electric motor 20 so that if there is insufficient drive from the engine the pump 10 may be powered by the electric motor. Freewheel mechanism 16, 22, eg sprag clutches, permit the gearing 14, eg epicyclic gearing, and electric motor 20 to rotate the pump 10 in one direction. An outlet 34 of the pump 10 is connected to a ball valve 38 which opens, when the actuating system is not in use, to allow fluid to drain to a reservoir 32 after charging an accumulator 44 to a required pressure that is sensed by a pressure switch 64 connected to a ECU 66. In another embodiment a pressure transducer (120, fig 3) controls, via the ECU 66, a solenoid operated proportional control flow valve (138) in order to charge the accumulator 44.

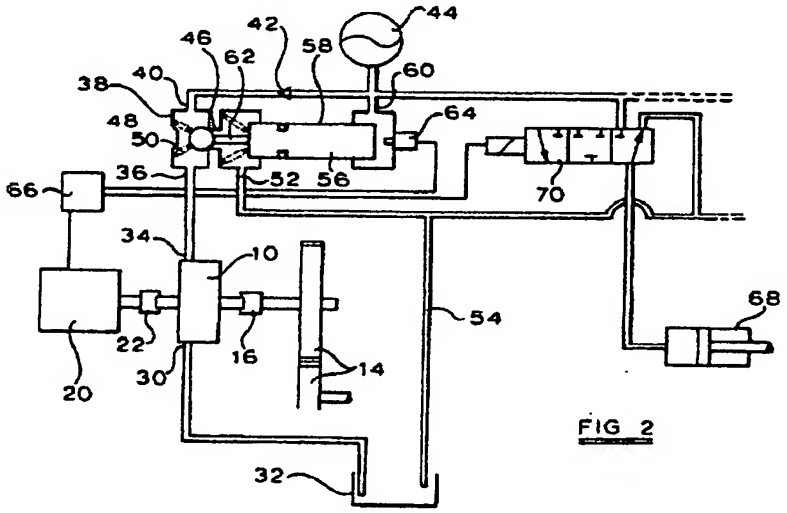

FIG 2

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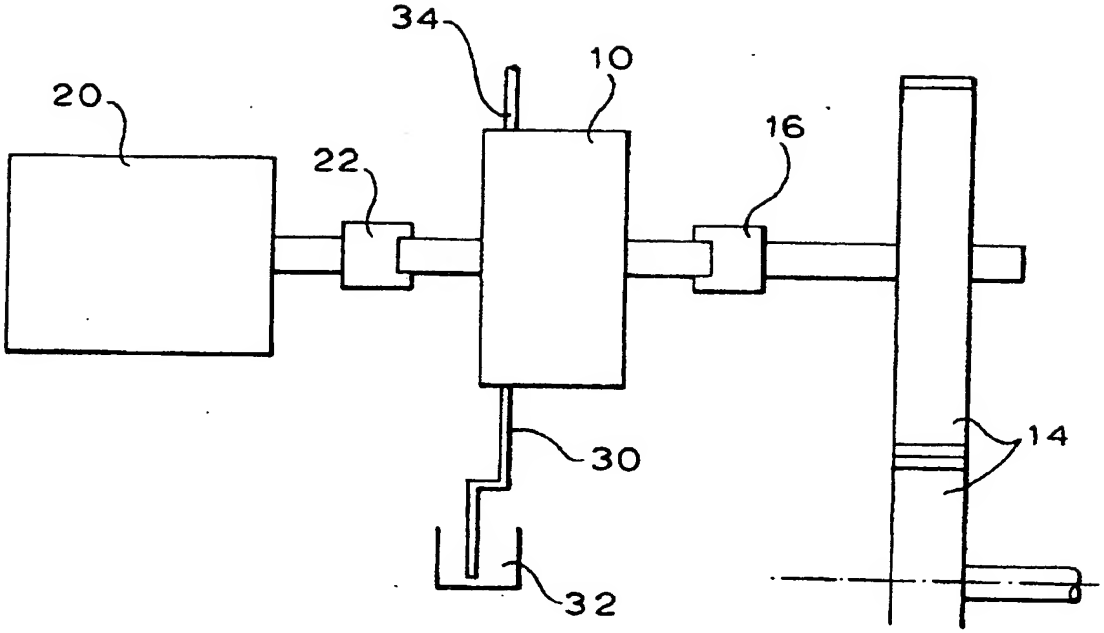

FIG 1

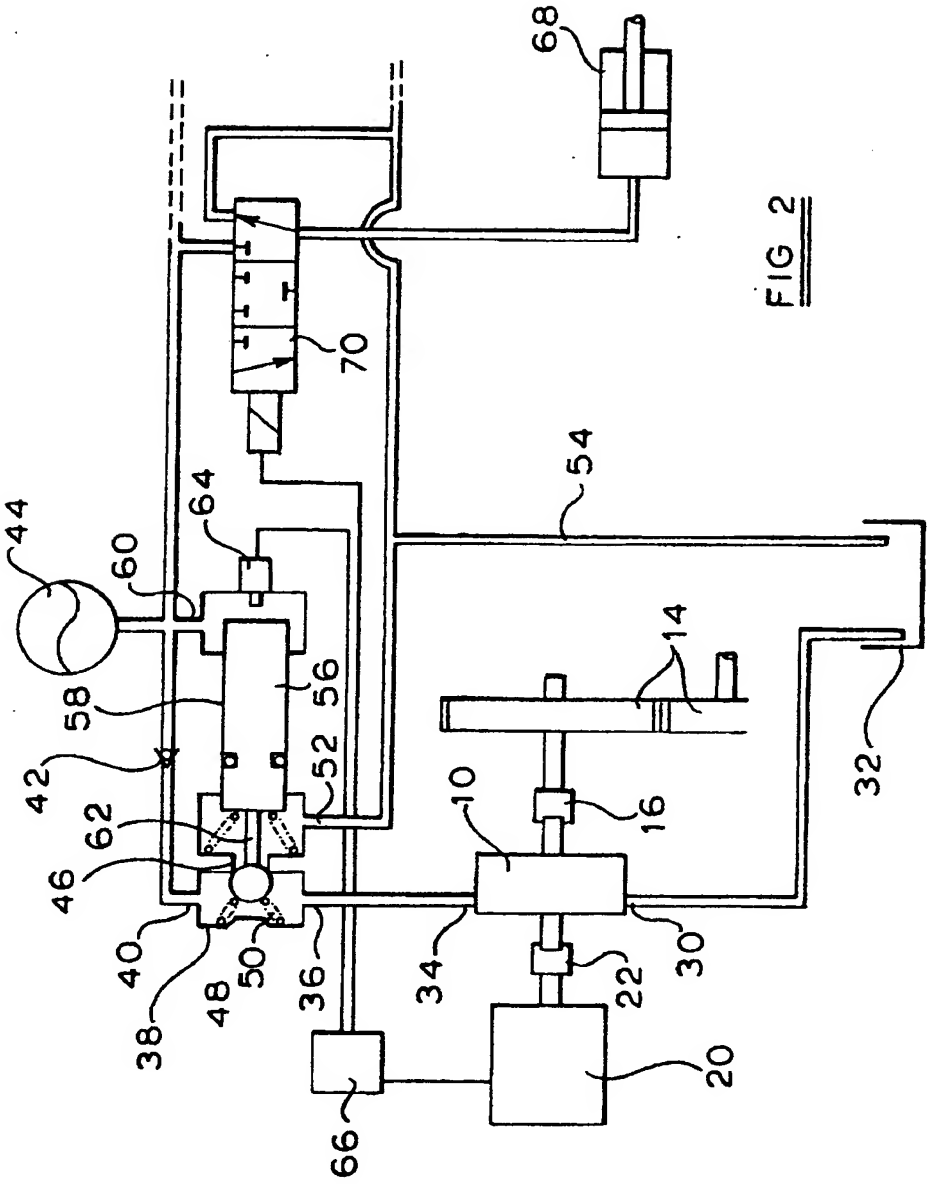
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FIG 2

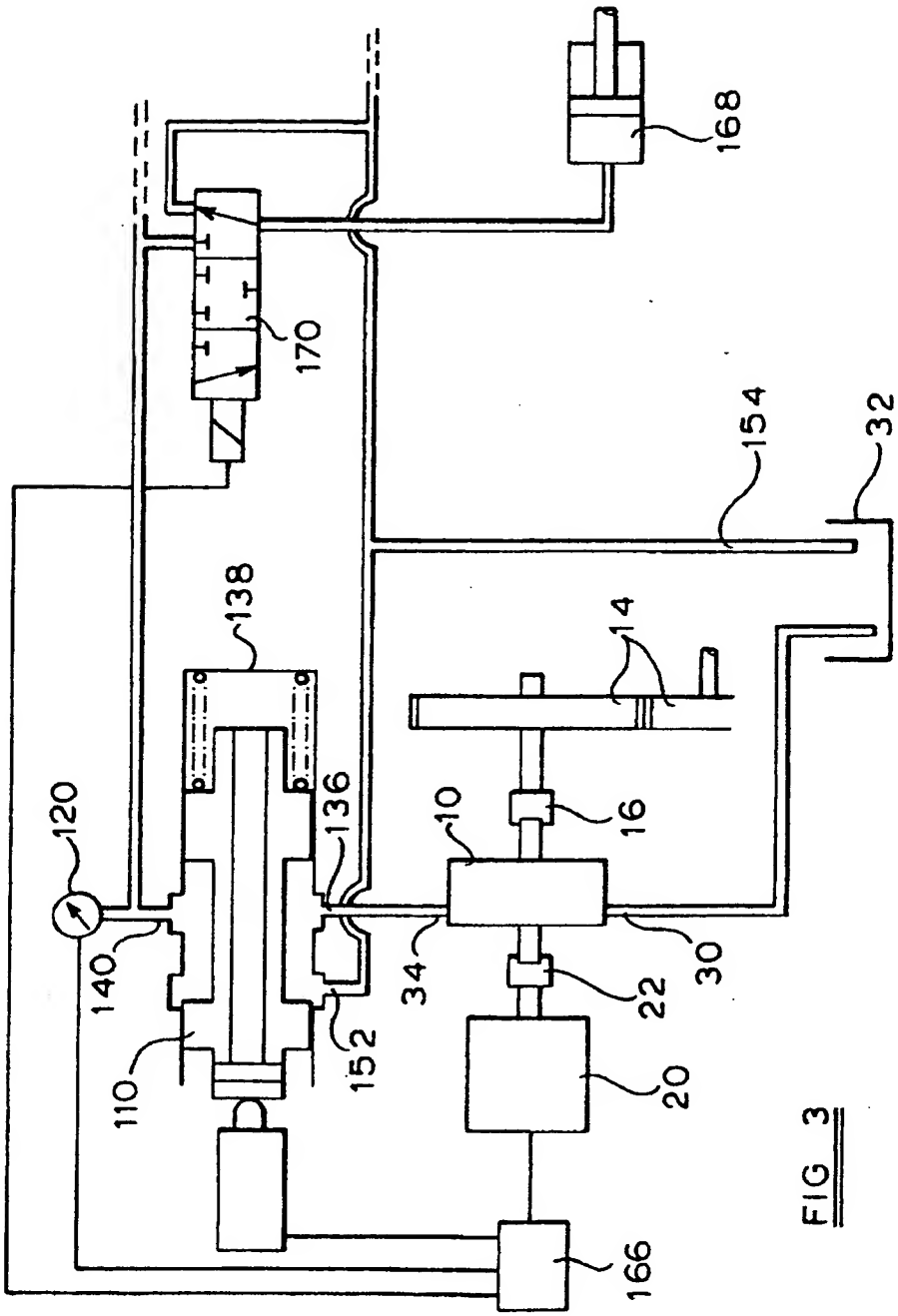

FIG 3

DUAL PUMP DRIVE

The present invention relates to a dual pump drive for a hydraulic actuating system and in particular, although not exclusively, to a dual pump drive for the hydraulic actuating system of an automatic transmission system of a vehicle, of the type covered by the applicant's European Patent Nos 0038113; 0043660; 0059035 and 0101220.

In transmission systems of the type covered by the above-mentioned patents, the vehicle clutch and gear selector mechanisms are controlled automatically, by hydraulic means. Hydraulic power is provided by a pump which may be used to charge a hydraulic pressure accumulator. Hitherto, the pump has normally been driven by an electric motor.

It has however been proposed to drive the pump mechanically from the vehicle engine or transmission. If however a vehicle with such a system is parked in gear, pressure in the hydraulic actuating system will be lost and consequently it will not be possible to disengage the gear in order to restart the engine. This problem may be overcome by the use of a separate electric motor driven pump which may be energised from the vehicle's battery, to provide power to disengage the gear, so that the engine may be restarted. This solution however requires duplication of the pump and negates much of the advantage of using an engine/transmission driven pump in place of an electrically driven pump.

According to one aspect of the present invention a hydraulic actuating system for an automatic transmission system of a motor vehicle, includes pump means, said pump means being adapted to be drivingly connected to an engine or the transmission system of a vehicle through a mechanical drive including a freewheel mechanism, the pump additionally being adapted to be drivingly connected to an electric motor.

With the hydraulic actuating system disclosed above, when the engine or vehicle is stationery or when the drive to the pump from the engine or transmission is insufficient to maintain the required pressure in the actuating system, the pump means may be driven by the electric motor. The pump will otherwise be driven by the engine or transmission.

The hydraulic system driven by the pump may be either a closed centre system in which pressure is built up in the system and stored, for example, in a hydraulic pressure accumulator; or an open centre system in which the pump continuously circulates the fluid through the system, until a load demand is applied.

The invention will now be described by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic view of a pump with a dual drive, for use in a hydraulic actuating system in accordance with the present invention;

Figure 2 illustrates diagrammatically a closed centre hydraulic actuating system in accordance with the present invention; and

Figure 3 illustrates diagrammatically an open centre hydraulic actuating system in accordance with the present invention.

As illustrated in Figure 1, a pump 10 which may be, for example, a gear pump, a vane pump or a multi piston positive displacement pump, has a driveshaft 12 which extends to both sides of the pump 10.

On one side of the pump 10, the driveshaft 12 is connected to an engine or transmission of a vehicle, via a gear train 14 and a first freewheel mechanism 16. On the other side of the pump 10, the driveshaft 12 is

coupled to an electric motor 20 via a second freewheel mechanism 22. The freewheel mechanisms 16 and 22 may of any suitable form, for example sprag clutches, which will permit the gear train 14 and electric motor 20 to rotate the pump rotor in one direction while isolating the gear train 14 from the drive of the electric motor 20 and the electric motor 20 from the drive of the gear train 14.

As illustrated in Figure 2, the pump 10 illustrated in Figure 1, may be used to drive a closed circuit hydraulic actuating system. As illustrated in Figure 2, an inlet to the pump 10 is connected to a hydraulic fluid reservoir 32 and an outlet 34 from the pump 10 is connected to the inlet 36 of a charging valve 38. An outlet 40 from the valve 38 is connected via non-return valve 42 to a hydraulic pressure accumulator 44.

The valve 38 defines a valve seat 46 and a ball valve 48 is biased into engagement with the valve seat 46 by compression spring 50. The inlet 36 and outlet 40 are connected to a further outlet 52, via the valve seat 46. The outlet 52 is connected to the reservoir 32 by return line 54.

The valve 38 has a piston 56 which is slidingly located and sealed with respect to a bore 58. The diameter of the piston 56 is greater than that of the seat 46 and the accumulator 44 is connected to the valve 38 by inlet 60, at the end of piston 56 remote from the ball valve 48. A small diameter extension 62 of the piston 56 engages the ball valve 48.

When the ball valve 48 is closed and the pump 10 is driven, hydraulic fluid pressure acting on the ball valve 48 and the end of piston 56 remote from the ball valve 48, will urge the piston 56 towards the ball valve 48, against the load applied by spring 50. When the accumulator reaches the required charging pressure, the ball valve 48 is unseated permitting fluid to flow through the seat 46 back to the reservoir 32.

A pressure switch 64 is provided adjacent the end of piston 56 remote from the ball valve 48, said pressure switch 64 providing a signal to an ECU 66, which may be used to de-energise the electric motor 20 when the piston 56 moves to unseat the ball valve 48 or to energise the electric motor 20 when the piston 56 moves back as pressure in the accumulator falls below a predetermined value.

The hydraulic pressure accumulator 44 is connected to the slave cylinders or hydraulic actuators 68 of one or more systems, for example a clutch actuator or gear selector mechanism, by a suitable control valve 70.

With the system described above, when the pump 10 is driven by the engine or transmission of the vehicle, unlike the electric drive, it will be driven continuously. The charging valve 38 will act in the manner described above to maintain the pressure in the pressure accumulator 44 and will permit the hydraulic fluid to be recirculated to the reservoir 32, when the pressure accumulator 44 is at the required pressure.

In the hydraulic actuating system disclosed in Figure 3, the outlet 34 from the pump 10 is connected to an inlet 136 of a solenoid operated proportional flow control valve 138. A first outlet 140 from the valve 138 is connected to the slave cylinder or hydraulic actuator 168 of one or more systems, for example clutch actuation or gear selector mechanisms, via suitable control valves 170. A second outlet 152 from the valve 138 is connected to return line 154 to the reservoir 32.

In a first position of the valve 138, the inlet 136 is connected to both inlets 140 and 152. Fluid pumped from the pump 10 will thus be recirculated back to the reservoir 32. The connection to outlet 140 will permit priming of the various hydraulic control circuits connected to the pump 10.

To actuate one or more of the hydraulic control circuits, the solenoid valve 138 is energised so that a spool 110 will move closing outlet 152, so that the full flow from the pump 10 is directed to outlet 140 and thus to the hydraulic control circuits which may then be actuated as required by control valves 170.

A pressure transducer 120 is provided in the line connecting outlet 140 to the control circuit. The pressure transducer 120 is used to control the solenoid valve 138 via a ECU 166, to control the pressure in the hydraulic control circuits by opening and closing the outlet port 152, thus permitting some of the fluid pumped to be recirculated to reservoir 32.

Various modifications may be made without departing from the invention. For example, the charging valve 38 of the embodiment illustrated in Figure 2 may be replaced by a solenoid operated flow control valve and pressure transducer, similar to those used in the embodiment illustrated in Figure 3, in order to control charging of the pressure accumulator 44.

Furthermore, rather than positioning the electric motor and mechanical drives to the pump on opposite sides of the pump, the driveshaft of the pump may only extend to one side of the pump, the electric motor and mechanical drives being connected thereto, via freewheel mechanisms, in suitable manner. Furthermore, while in the above embodiment freewheel mechanisms are provided on both drive connections, it is not essential that the electric motor be prevented from being driven by the mechanical drive and consequently a single freewheel mechanism isolating the mechanical drive from the drive from the electric motor, may be used.

According to a further embodiment of the invention the engine or transmission system and the electric motor are connected to the pump by a drive connection, for example an epicyclic gear mechanism by which

drive from the two sources will be additive. In this manner if insufficient power is available from the vehicle transmission, for example at low speeds, the electric motor may be used to augment the power delivered by the transmission system.

CLAIMS

1. The hydraulic actuating system for an automatic transmission system of a motor vehicle including pump means, said pump means being adapted to be drivingly connected to an engine or the transmission system of the vehicle through a mechanical drive including a freewheel mechanism, the pump additionally being adapted to be drivingly connected to an electric motor.

2. A hydraulic actuating system according to Claim 1 in which the mechanical drive and electric motor are connected to a driveshaft of the pump means on opposite sides of the pump means.

3. A hydraulic actuating system according to Claim 1 or 2 in which the pump is drivingly connected to the engine or transmission system of the vehicle through a gear train.

4. A hydraulic actuating system according to Claim 1 or 2 characterised in that the engine or transmission system and the electric motor are connected to the pump by a drive connection by which drive from the two sources will be additive.

5. A hydraulic actuating system according to Claim 4 characterised in that the engine or transmission system and the electronic motor are connected to the pump via an epicyclic gear mechanism.

6. A hydraulic actuating system according to any one of the preceding claims in which a freewheel mechanism is provided in the drive between the pump and the electric motor.

7. A hydraulic actuating system according to any one of the preceding

claims in which the outlet from the pump is connected to the hydraulic actuating system by valve means, said valve means being adapted when the actuating system is not in use to connect the output from the pump to a drain to a hydraulic fluid reservoir.

8. A hydraulic actuating system according to Claim 5 in which the actuating system is a closed centre system having a pressure accumulator, the valve means serving to control charging of the pressure accumulator to the required pressure.

9. A hydraulic actuating system according to Claim 6 in which the valve means is a mechanical pressure control valve which closes the connection between the outlet from the pump and the drain to reservoir, when pressure in the pressure accumulator is below the required pressure and opens the connection between the outlet from the pump and the drain to reservoir, when the pressure accumulator is at the required pressure.

10. A hydraulic actuating system according to Claim 6 in which charging of the pressure accumulator is controlled by a solenoid operated valve.

11. A hydraulic actuating system according to any one of Claims 1 to 5 in which the actuating system is an open centre actuating system valve means controlling flow of fluid from the outlet from the pump to the actuating system or to a drain to reservoir.

12. A hydraulic actuating system according to Claim 9 in which the valve means is a proportional control flow valve.

13. A hydraulic actuating system according to Claim 10 in which a pressure transducer is provided in the actuating system, to control the

solenoid operated proportional flow control valve.

14. A hydraulic actuating system according to any one of the preceding claims in which means is provided to control the electric motor, said means energising the electric motor when pressure in the actuating system is below the required level and drive from the engine or transmission system is not sufficient to attain the required pressure, the electric motor being de-energised when pressure in the actuating system is at the required level.

15. A hydraulic actuating system substantially as described herein with reference to and as shown in Figures 1 to 3 of the accompanying drawings.

Application No: GB 9911022.3
Claims searched: 1 to15

Examiner: Mike McKinney
Date of search: 10 November 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F2D (DCG, DJ).

Int Cl (Ed.6): F16H 57/04.

Other: ONLINE: WPI; EPODOC; JAPIO.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2273323 A	(HONDA) see, for example, fig 3.	1 to 4.
X	EP 0821187 A2	(TOYOTA) see whole document.	1 to 6.
A	WO 97/40298 A1	(ZF)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.